SANITARY MILK HOUSES

Plans and Construction Details

(1933 Edition)

A SANITARY, well-designed milk house in which milk can be cooled and stored at low temperature until delivered is an important and necessary improvement for every farm that produces milk for sale.

When properly cooled, milk can be kept sweet and of good flavor for long periods, because the bacteria which cause milk to sour multiply slowly when milk is clean and cool.

Practically all sanitary milk regulations now require that each producer have a separate milk house which shall be used for no other purpose than the handling and storing of milk. These regulations usually require that the milk house be well lighted, that the floors be constructed of concrete or other impervious materials, and that the walls and ceilings be easy to clean.

Plans for Milk Houses

This circular presents a number of selected milk house plans for both wholesale dairies, which sell milk in bulk to plants that bottle and distribute it, and retail dairies doing their own bottling and distributing.

These plans were designed by experienced agricultural engineers who have made a careful study of the requirements for modern milk houses. Many helpful suggestions also were received from the Office of Milk Investigations, U. S. Public Health Service. All plans, except the one-room milk house plan, have been designed to comply with the requirements of the Public Health Service Milk Ordinance and Code.

The best type of milk house for any individual dairyman to build will depend upon the amount of milk to be handled, the manner in which it is to be marketed and the regulations in the city where the milk is to be sold. If it is intended to sell milk for city delivery, it is well to have the local health department approve the plans—to make certain that the milk house will comply with the local ordinance requirements. Probable future needs also should be kept in mind. Money will be saved when a milk house that will satisfy both present and future requirements is erected.

Where raw milk is to be sold in bulk directly to a plant, the usual cooling method is to set the cans of milk in cold water. Where milk is bottled on the farm for retail delivery, common practice is to use a surface cooler and a dry box type of refrigerator.

When to Construct Insulated Tank

Milk regulations often require that milk be cooled to 50 degrees F. or lower, in which case it usually is necessary to use ice or mechanical refrigeration as the temperature of running well or spring water generally is above 50 degrees in summer. Running water may be used to pre-cool milk—that is, to lower its temperature by about 20 or 30 degrees immediately after it is drawn. This pre-cooling saves ice or lowers the cost of mechanical refrigeration.

The cooling tank should be insulated when ice or mechanical refrigeration is used. Another advantage of an insulated tank is that it prevents water from freezing. See pages 4 and 5 for construction details.

Cooling Tank without Insulation

Where regulations do not require that milk be cooled below 60 degrees F., or where milk or cream is to be sold to a dairy products plant which does not require cooling below this temperature, or where a plentiful supply of cold water is available, a tank without insulation can be used. However, in building a tank of this type, it is desirable to make it of such size that it later can be converted into an insulated tank.

Practically all sanitary regulations now require that each producer have a separate milk house used for no other purpose than the handling and storing of milk.

Building the Milk House

THE foundation should be carried down to solid footing and deep enough to prevent upheaval by frost. Concrete masonry (concrete block or concrete building tile) is often used for foundation walls, in which case a concrete footing is placed on which to start the wall. Monolithic foundations generally are built at least 12 inches above the floor level and in many cases from 24 to 36 inches above. Forms are made with 1-inch boards, well braced. An opening 12 inches square is left in the wall for a drain pipe.

The proper concrete mixes for footing and foundation walls are given on page 8 under the heading, "How to Make Good Concrete." Read these instructions carefully. The concrete is placed in the forms immediately after mixing. It is deposited evenly in layers not more than 6 inches deep and is tamped and spaded to compact it and produce a dense mass.

Building the Walls

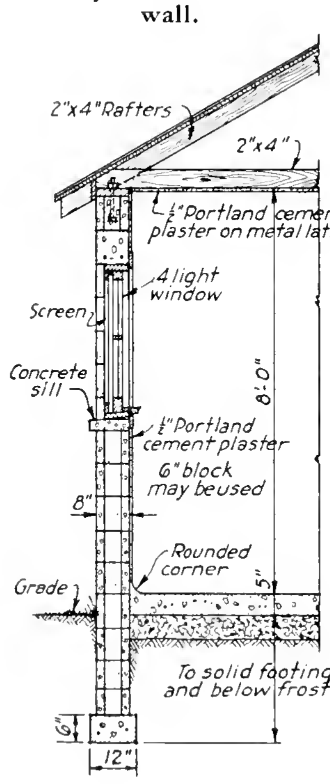
The drawings on this page show two common types of construction for milk house walls. Fig. 1 shows an 8-inch concrete masonry wall laid in portland cement-lime mortar, mixed in the proportion of 1 sack of portland cement, 1 cubic foot of hydrated lime and 6 cubic feet of clean, well-graded sand. This amount will make enough mortar to lay up approximately 120 concrete block (8 by 8 by 16-inch) or 175 concrete building tile (5 by 8 by 12-inch).

Door and window frames are set in place as the wall is laid. A plate for attaching the roof to the wall is fastened with bolts, 4 feet apart, in the top course of masonry. Reinforced concrete lintels are used over all openings.

To aid in cleaning, inside walls and ceilings are plastered with portland cement mortar applied in two coats, the second coat 24 hours after the first. The plaster mix consists of 1 sack of portland cement, 2 cubic feet of clean plastering sand and 10 pounds of hydrated lime. Finish coat is troweled smooth.

Fig. 2 illustrates a cross section of a milk house wall with frame construction on a concrete foundation. To provide an easily cleaned surface, inside walls above the foundation are covered with two coats of portland cement plaster applied on small-mesh metal reinforcement, the second coat being put on 24 hours after the first. The first coat is roughened to provide bond for the finish coat. The latter is troweled smooth. The ceiling also is given two coats of portland cement plaster. Mix plaster in the proportion of 1 sack of portland cement, 2 cubic feet of plastering sand and 10 pounds of hydrated lime.

Fig. 1—Concrete masonry foundation and wall.

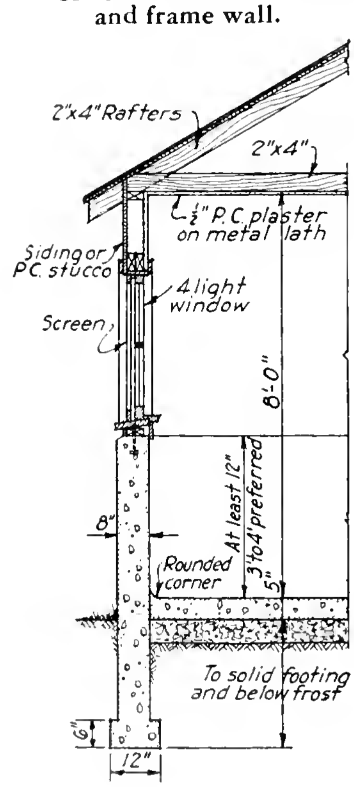


Concrete masonry units are large in size for speedy, economical construction.

Milk House Floor

After the milk cooling tank has been completed, the floor is placed. One-course construction is recommended—that is, the full thickness (5 inches) is placed in one operation. Corners are rounded to eliminate angles that hold dirt. The floor is sloped toward the drain with a pitch of ¼ inch per foot. See Table 3, page 8, and read carefully information on "How to Make Good Concrete."

Fig. 2 — Monolithic concrete foundation and frame wall.



The concrete mixture should be rather stiff, requiring some tamping to get it to settle into place. After it has been deposited and struck flush with a straightedge, a wood float is used to even up the surface and prepare it for final finishing with a steel trowel.

Final finishing is delayed until the concrete is stiff enough to require some pressure of the thumb to dent it. A steel trowel, when applied after the concrete has stiffened somewhat, causes fine grains of sand to be pushed down into the concrete, producing a dense, smooth surface that wears well. The surface of the floor should be kept moist for seven days.

Two-Room Milk House

THE two-room milk house, plans for which are given on this page, is designed to fulfill the needs of a wholesale dairy producing up to 80 gallons of milk a day when the morning's milk is delivered uncooled. When the night's milk and the morning's milk are placed in the cooling tank at the same time, capacity of plan shown is 40 gallons per milking. For compliance with the Public Health Service Milk Ordinance and Code, chlorine rinse is assumed.

The capacity of this house can be increased to accommodate 6, 8 or more cans. For each additional pair of ten-gallon cans of milk to be cooled, increase both the width of the milk room and the length of the tank 2 feet 2 inches. The width of the house is not changed nor are the dimensions of the wash room. This two-room house will meet the requirements of practically all city milk regulations.

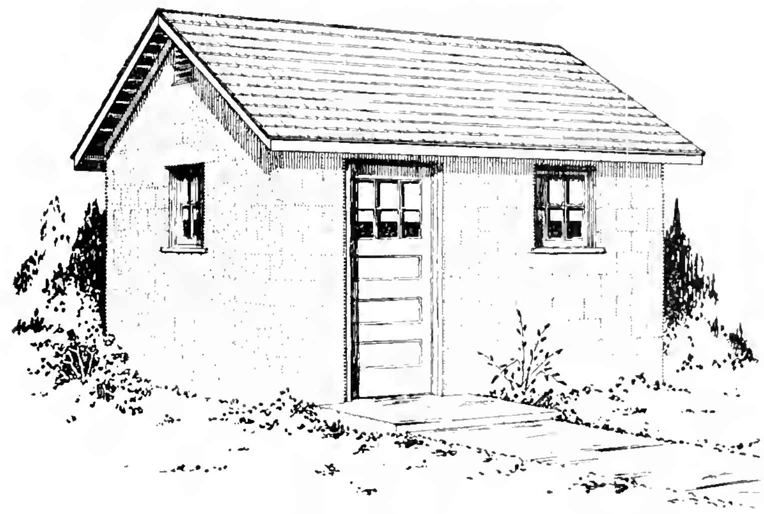


Fig. 3—Drawing of exterior of two-room milk house.

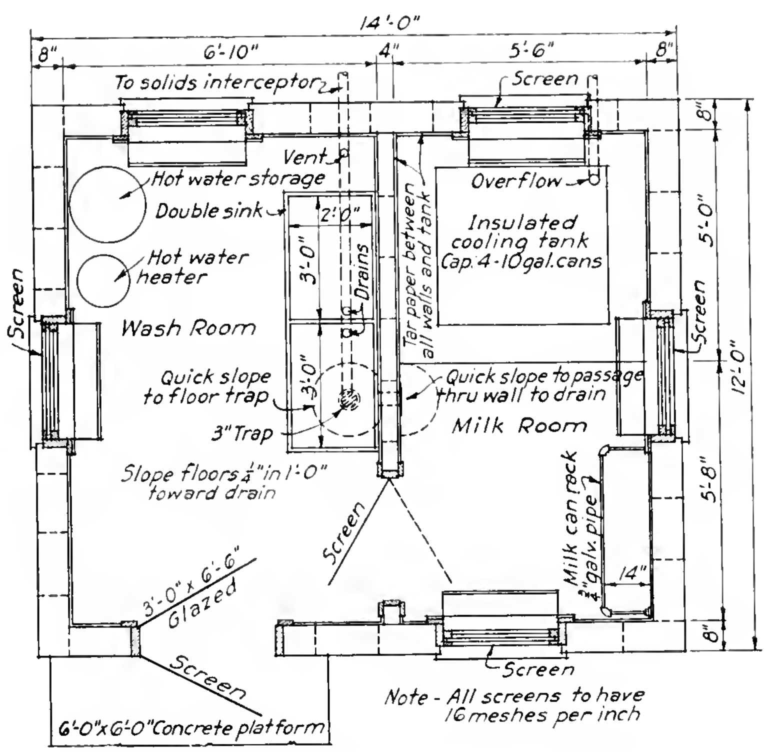


Fig. 4—Floor plan for two-room milk house.

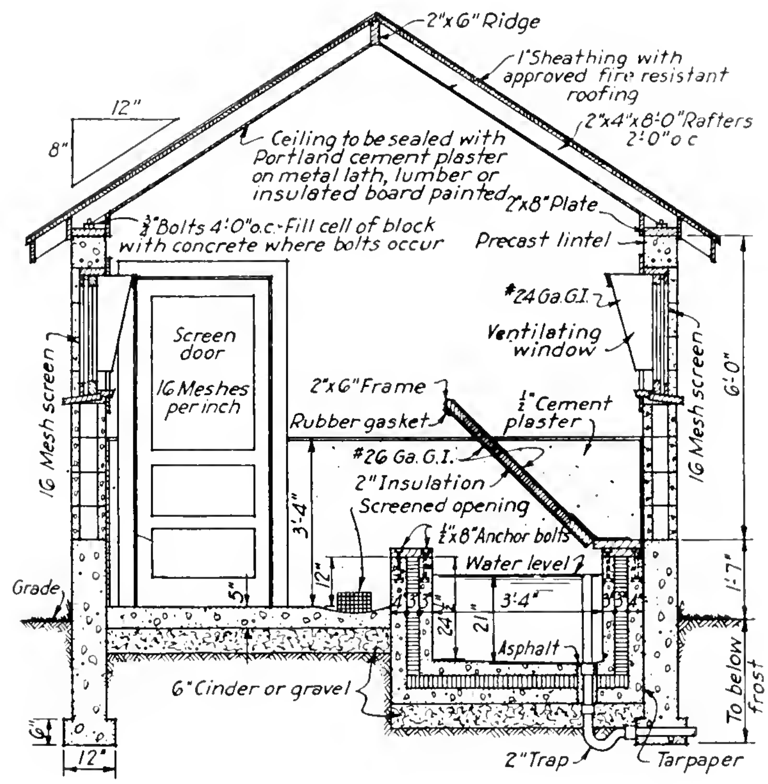


Fig. 5—Cross sectional view of two-room milk house.

Concrete Materials Required
Two-Room Milk House
12 by 14 Feet, Outside Dimensions

Footing and Foundation: Estimate based on 1 part cement, 2¾ parts sand, 3¾ parts crushed stone or pebbles. Foundation wall assumed to extend 1 foot 7 inches above ground and 2 feet below. Requires 28 sacks of portland cement, 3 yards sand and 4 yards pebbles or crushed stone.

Floor and Platform: 5 inches thick. Estimate based on 1-2¼-3 mix. Requires 14 sacks portland cement, 1¼ yards sand and 1¾ yards pebbles or crushed stone.

Wall: Requires 260 concrete block, 8 by 8 by 16 inches; 36 corner block, 8 by 8 by 16 inches; 48 half-block, 8 by 8 by 8 inches; 86 block, 4 by 8 by 16 inches; and 20 block, 4 by 8 by 8 inches.

Mortar for laying block—1 part portland cement, 1 part lime and 6 parts sand. Requires 3½ sacks portland cement, 3½ cubic feet lime and ¾ yard sand.

Mortar for plastering ceiling and base of wall to height of 3 feet 4 inches—1 part cement, 2 parts sand and ¼ part lime. Requires 6½ sacks cement, ½ yard sand and 65 pounds lime.

Cooling Tank: See Table 2 on page 5 for estimate of materials to construct cooling tank.

Constructing the Cooling Tank

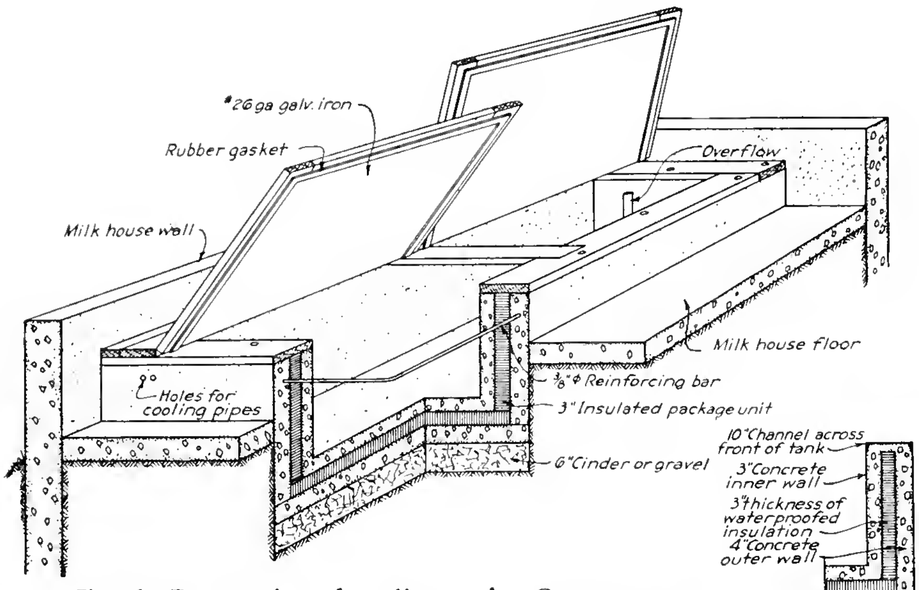


Fig. 6—Perspective of cooling tank. Corner cut out to show construction. Alternate design for tank rim shown at right.

What Size Tank to Build

The proper size tank to build will depend upon the number of cans it is to hold plus the necessary cooling water. To obtain rapid, efficient cooling, there should be about three times as much water in the tank as there is milk in the cans.

Table 1 shows inside dimensions for tanks holding from four to twelve cans (40-quart size), and the proper amount of water. Space is also provided for ice or the cooling coils for refrigerating units. A tank in which ice is used for cooling can later be equipped with mechanical refrigeration.

Locating the Tank

Most dairymen locate the cooling tank against one wall of the milk room. The labor of lifting cans in and out of the tank is made easier and insulation improved when the tank is placed partly below the floor level. The excavation should be slightly larger than the outside dimensions of the tank to allow room for setting forms. The hole is dug 2 feet 5 inches below the level of the finished floor.

Overflow and Drain

Fittings for the overflow and drain are set so that the top of the coupling in which the overflow pipe is screwed will be flush with the finished floor in the tank. When the overflow pipe is removed this outlet serves as a drain. A good location for the overflow pipe is in the middle of one end about 5 inches from the inside wall. The overflow pipe and coupling may be of brass or wrought iron and the trap of cast iron or vitrified pipe.

Table 1—Inside Dimensions of Insulated Milk Cooling Tank for Ice or Mechanical Refrigeration

Capacity of Tank						
Total Storage Capacity 40-Qt. Cans	Cans Cooled per Milking—One Cooling Daily 40-Qt. Cans	Cans Cooled per Milking—Two Coolings Daily 40-Qt. Cans	Capacity of Tank Gallons	Inside Length Inches	Inside Width Inches	Inside Depth to Plate Inches
4	4	2	170	46	40	25
6	6	3	260	72	40	25
8	8	4	350	98	40	25
10	10	5	450	124	40	25
12	12	6	550	150	40	25

NOTES FOR TABLE 1:—Where night's milk is allowed to remain in the tank while morning's milk is cooled, a tank large enough to hold the cans from *two* milkings is needed. Where only the night's milk is cooled, or where the cooled night's milk is taken out to make room for the morning's milk, the tank need be only large enough to hold the cans from *one* milking.

Constructing Base Slab

A fill of cinders, gravel or coarse sand 6 inches deep is recommended, tamped to make an even, firm base. The concrete base is made 4 inches thick. The mixture should be fairly stiff, and should be carefully leveled off to provide an even surface on which to lay the insulation.

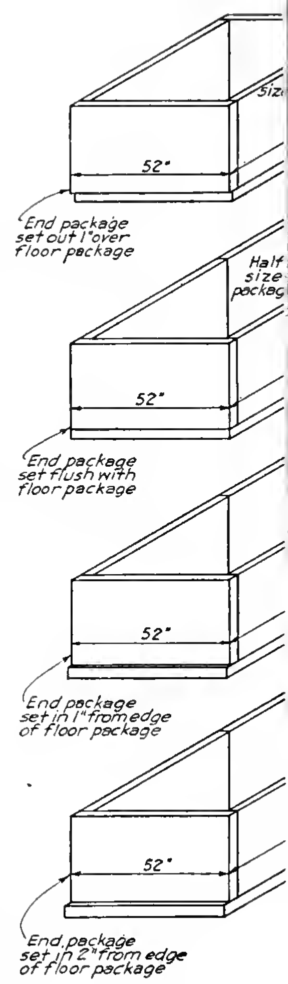


Fig. 7—Arrangeme
units for 4, 6, 8

Placing Insulation

Cork board or other prepared insulating material 3 inches thick is used. Several manufacturers now furnish large size packages of waterproofed insulation, usually 28 inches wide, 52 inches long and 3 inches thick. A 4-can tank requires six packages, two for the floor and four in the walls. A 6-can tank requires eight; an 8-can tank, 10; and a 10-can tank, 12 packages. The proper placing of the packages for tanks of different sizes is shown in Fig. 7.

Floor insulation is placed first, being laid on the concrete base. A hole is cut in the package placed over the drain pipe, leaving a ½-inch opening all around the pipe to be filled with hot asphalt. The insulating packages for the end and side walls are then erected. In the case of a 6-can tank or 10-can tank it will be necessary to saw one of the packages into two equal size pieces. The raw edges exposed by sawing are waterproofed by painting with hot asphalt. Also apply hot asphalt or seam filler at all joints where packages butt together.

When package units of insulation are not available, use cork board 3 inches thick, which comes in pieces 1 foot wide and 3

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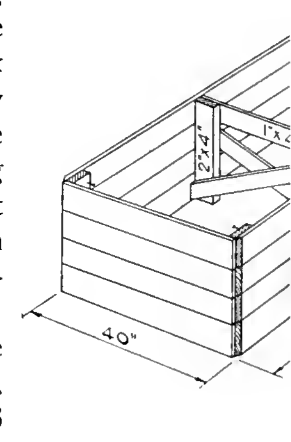

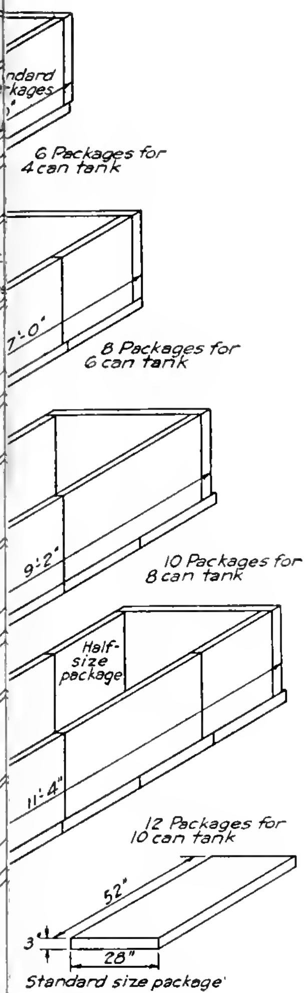

of insulation package
8 and 10-can tanks.

feet long. Since cork board loses its value as an insulator when wet, it must be kept absolutely dry. It is waterproofed by mopping it with hot asphalt on all surfaces. Edges are again painted with the hot asphalt when the pieces are fitted together. The cork board should be cut to fit before being waterproofed. As a further precaution to keep out moisture, cork board is covered with a woven cotton fabric and again mopped with hot asphalt.

Forms for Wall

Forms are made of 1-inch dressed and matched lumber stiffened with 2 by 4-inch studs and are erected after insulation is in position and all measurements are checked. Faces of the inner and outer forms are held exactly 10 inches apart by placing spacers—wood blocks 4 inches long—between outer form and the insulation; blocks 3 inches long between insulation and inner form face. These blocks are removed as forms are filled with concrete. Where the tank extends entirely across the end of a milk house the foundation wall serves as the outer form on the ends and one side of the tank. Place a strip of tar paper against the foundation wall to separate the tank and the wall. Then any settlement of the wall will not damage the tank. Form faces coming in contact with the concrete mixture should be lightly oiled. Oil from the automobile crankcase is satisfactory.

Mixing and Placing Concrete

The correct mixture is given in Table 3. Read carefully section, "How to Make Good Concrete," on page 8. Place floor first, sloping it slightly toward the drain. Place a tin collar around the drain, leaving a ½-inch space. When concrete has hardened this collar is removed and the space filled with hot asphalt. Concrete for the walls is placed in the forms in layers 4 inches deep, care being taken to fill both the inner and outer walls to the same depth in order not to move the insulation. As the concrete is placed it is spaded. Spade carefully so as not to damage the waterproof covering on the insulation. When forms are filled to within 4 inches of the top, place a ⅜-inch reinforcing bar in the center of the outer wall, extending around the tank. Lap splices 15 inches.

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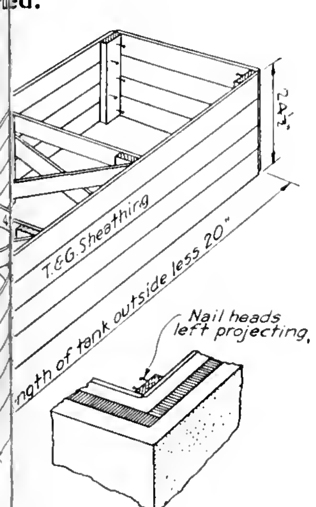

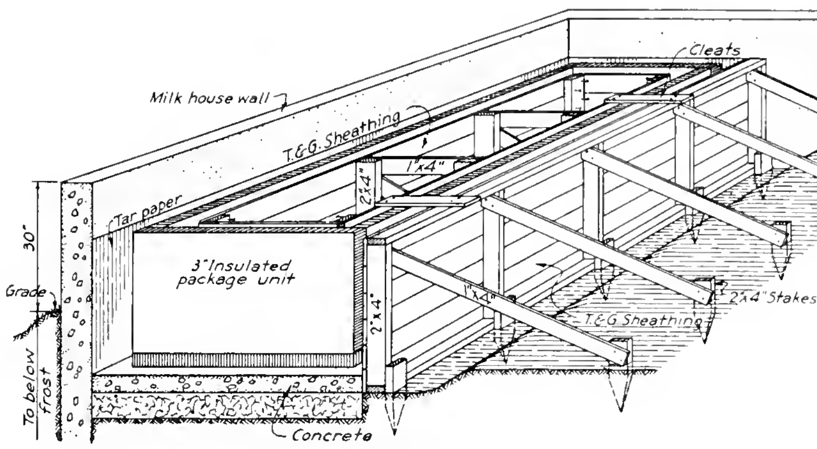

Fig. 8—Forms for building the walls of tank.

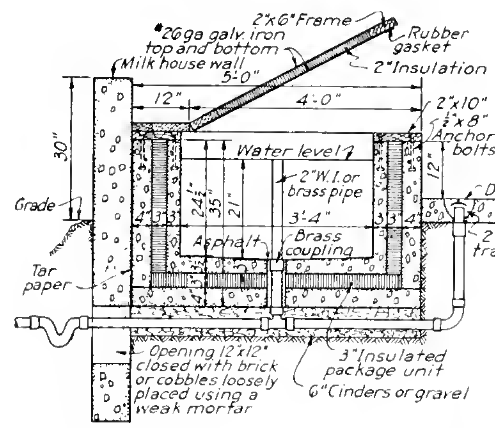

Fig. 9—Cross section of insulated cooling tank.

When the forms are completely filled, ½ by 8-inch anchor bolts are set 2 feet apart in the concrete with threaded ends projecting about 1¾ inches. The plate or rim for the cover is attached to these bolts.

In warm weather the forms usually can be removed in 24 hours. More time should be allowed in cool weather. After the forms are removed, the inside of the tank is painted with a wash of cement and water having about the same consistency as thick cream. The concrete should be cured by covering the tank with burlap and keeping it constantly moist for seven days. This curing is essential to secure a strong, watertight concrete. (*Turn to page 6.*)

Table 2—Quantities of Materials for Insulated Concrete Tanks

(All tanks 40 inches wide, 25 inches deep, inside dimensions)

Materials	Unit of Measurement	Size of Tank				
		4-Can	6-Can	8-Can	10-Can	12-Can
3-inch Insulation	3x28x52-inch packages	6	8	10	12	14
Cement	Sacks	11	14	17	21	24
Sand	Cu. Ft.	22	28	34	42	48
Pebbles	Cu. Ft.	22	28	34	42	48
Reinforcing rods ⅜-inch	Feet	22	27	31	37	42
2-inch Insulation	Sq. Ft.	14	20	26	31	40

NOTE:—Other materials needed include lumber for forms, lumber for plate and cover, tar paper, hinges, handles, nails, pipe fittings.

Constructing Rim and Cover

After the concrete has hardened, the plate or rim, consisting of 2 by 10-inch planks, is attached to the anchor bolts. A thin bed of mortar, 1 part portland cement and 2 parts sand, is spread over the top of the wall to secure a close fit for the plate. The nuts on the anchor bolts are counter-sunk in the plate so that the cover will close tightly. Sometimes a channel iron rim is placed across the front of the tank to protect it from damage by the milk cans. Pieces of strap iron screwed to the wood plate serve the same purpose.

The cover consists of a 2 by 6-inch framework filled with a 2-inch thick insulation and covered on the top and bottom with 26-gauge galvanized sheet metal. Rubber gaskets—old auto inner tubes or rubber weather stripping—are tacked around the edges of the cover to seal all joints. Hinges should be of galvanized metal. Covers for tanks 8 feet long or longer are built in two sections for greater ease in opening.

Constructing Tank without Insulation

In order that an uninsulated tank can be converted into an insulated tank later if so desired, it should be made to have the same outside dimensions as an insulated tank. Then the insulation and inner wall can be installed later. Follow the same general procedure as in building the insulated tank.

One-Room Milk House

THE one-room milk house shown here is designed for dairies selling milk or cream to dairy products companies.

Many milk ordinances now require a two-room house. As ordinances are revised, it is probable that an increasing number will require two rooms. In case it is intended to sell fluid milk, it is well to have milk house plans approved by the local milk inspector.

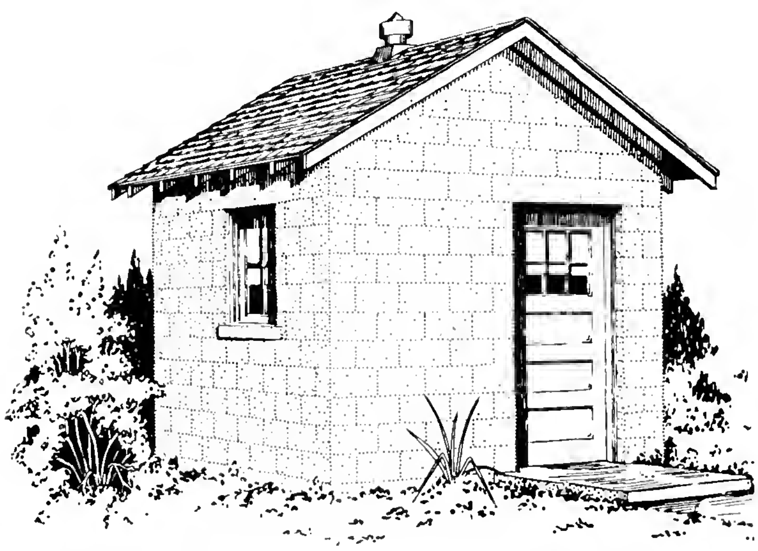

Fig. 11—Drawing of exterior of one-room milk house.

The capacity of this house can be varied by increasing or decreasing the width of the house and the length of the cooling tank. See pages 4 and 5 for details on cooling tank construction.

CONCRETE MATERIALS REQUIRED
One-Room Milk House
10 by 10 feet, Outside Dimensions

Footing and Foundation: Estimate based on 1-2¾-3¾ mix. Foundation wall assumed to extend 1 foot 6 inches above ground and 2 feet below. Requires 21 sacks of portland cement, 2¼ yards sand and 3 yards of pebbles or crushed stone.

Floor and Outside Platform: Five inches thick. Estimate based on 1-2¼-3 mix. Requires 6¼ sacks portland cement, ½ yard of sand and ¾ yard of pebbles or crushed stone.

Wall: Requires 252 block, 8 by 8 by 16 inches; 48 corner block, 8 by 8 by 16 inches; and 30 half-block, 8 by 8 by 8 inches.

Mortar for laying concrete block—1 part portland cement, 1 part lime and 6 parts sand. Requires 2¾ sacks cement, 2¾ cubic feet lime and ⅔ yard of sand.

Mortar for plastering ceiling and inside wall—1 part portland cement, ¼ part lime and 2 parts sand. Requires 6 sacks of portland cement, ½ yard of sand and 1½ cubic feet (60 pounds) of lime.

Cooling Tank: For estimate of materials required to construct cooling tank, see Table 2 on page 5.

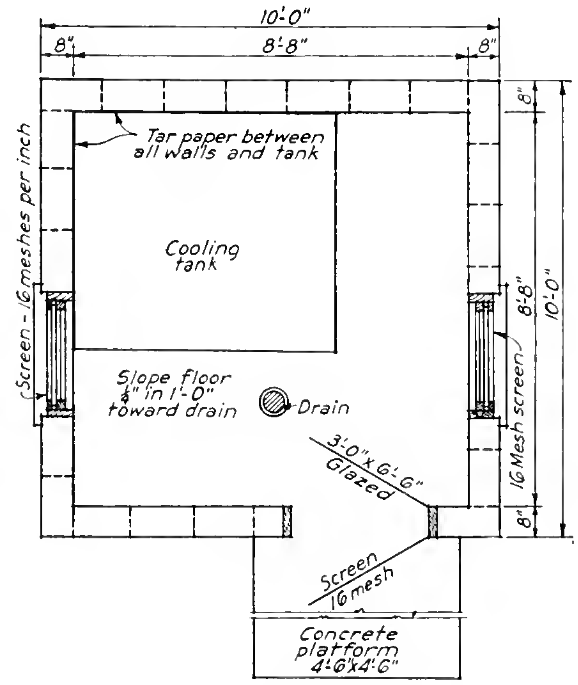

Fig. 12—Floor plan for one-room milk house.

Plans for Other Milk Houses

Small Retail Dairy

FIGURE 13 shows a plan for a small retail dairy, with space and equipment for handling up to 50 gallons of milk per day. This dairy is 20 feet 8 inches by 13 feet 4 inches, with a milk room for storing and bottling the milk, and a wash room for keeping equipment clean and sanitary. This plan is very economical in use of space and is convenient in arrangement. It will meet the requirements of practically all city health ordinances.

The boiler is in a shed outside the milk house, and may be either screened in or fully enclosed. The building should be so located that the boiler is at the corner farthest away from the barn. Walls of concrete masonry from foundation to plate are recommended in constructing this retail dairy.

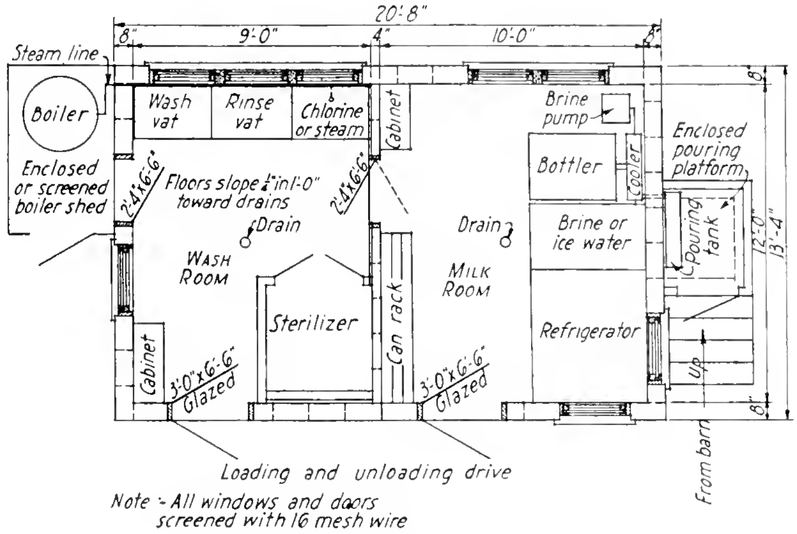

Fig. 13—Plan for small retail dairy.

Three-Room Milk House

PLAN for a three-room milk house is shown in Figure 14. This milk house is adequate in size and design for a wholesale dairy producing 80 to 160 gallons of milk daily, or for a retail dairy producing from 40 to 75 gallons per day. When used as a retail dairy, a bottling and capping machine will be required.

This three-room milk house is 28 feet 8 inches by 12 feet 8 inches in size, having the boiler room completely enclosed and providing adequate storage space for fuel.

If more convenient in respect to the location of the barn, the entrance to the milk room may be placed at the end of the building instead of on the side, reversing the refrigerator and the cooler and bottler.

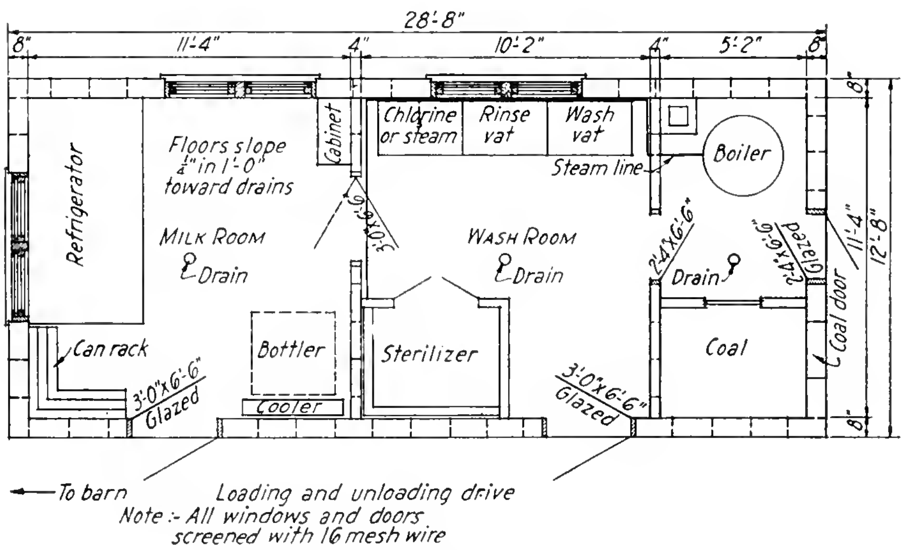

Fig. 14—Plan for three-room milk house.

Four-Room Milk House

FIGURE 15 shows a milk house designed to be highly economical in the use of floor space and highly convenient in use. When used as a wholesale dairy, it has a capacity of 160 gallons of milk per day, or is suitable for a retail dairy handling from 75 to 125 gallons of milk per day.

The milk house is 24 feet by 20 feet in size. The milk is brought from the barn into a small entrance room and can be placed in storage without going into the milk room. Likewise, milk cans may be taken from the storage rack without entering the milk or wash rooms. Boiler room and fuel bin are also enclosed.

The utmost cleanness and sanitation are secured with this design and arrangement of equipment, as it is not necessary to enter the wash room or milk room at any time except when actually working in them.

This four-room milk house will meet the requirements of practically all city milk regulations.

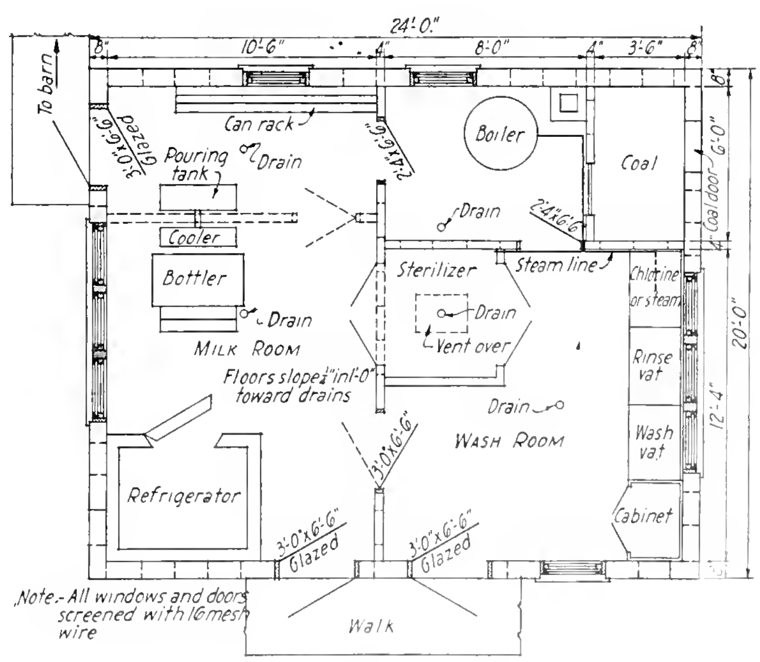

Fig. 15—Plan for four-room milk house.

How to Make Good Concrete

Sand and Pebbles

Sand should be clean and hard. Concrete made with dirty sand hardens slowly and may not develop the required strength. Sand should be well graded with particles varying from fine up to those which will pass a ¼-inch screen. Pebbles or crushed stone also should be clean and hard and range in size from ¼ inch up, according to the work. For footings and foundation walls, pebbles or crushed stone up to 1½ inches in size may be used. In the floor, pebbles up to 1 inch and in the cooling tank up to ¾ inch may be used.

Water

Mixing water should be clean. Water that is fit to drink is best.

Measuring Materials

All materials should be accurately measured. A pail marked to show quarts and gallons will be found handy for measuring water. A pail also may be used for measuring cement, sand, and pebbles. In mixing one-sack batches, remember that one sack holds exactly one cubic foot of cement. Then sand and pebbles are conveniently measured in bottomless boxes, made to hold one cubic foot, two cubic feet or other volumes desired.

Mixing the Concrete

Machine mixing is preferred. However, first class concrete can be mixed by hand. Whichever way is used, mixing is continued until every pebble is completely coated with a thoroughly mixed mortar of portland cement and sand.

Proportioning the Mix

Recommended proportions are given in Table 3 and are based on the amount of mixing water used per sack of cement. The strength, durability, watertightness and other desirable qualities of concrete are governed by the amount of mixing water used per sack of cement. That is why it is important to control the amount of mixing water. Allow for any moisture in the sand. The proper amount of water to add will depend on the condition of the sand.

For footings and foundation walls the recommended mix is 5½ gallons of water for each one-sack batch using *wet* sand. If sand is *damp*, add 6¼ gallons, and if *absolutely dry*, add 7 gallons of water. In these recommended proportions allowance has been made for water in the sand.

This is how to tell whether sand is wet, damp or dry, as figured in Table 3. Sand as it ordinarily comes from a pit is wet. It can be pressed into a ball in the hands. Damp sand contains only a slight amount of moisture. Dry sand is sand without surface moisture. Except for a thin layer on the surface of a pile, sand seldom is thoroughly dry. Usually it is wet or damp.

For the floor the recommended proportions are 5 gallons of water for each one-sack batch using *wet* sand, 5½ gallons for *damp* sand and 6 gallons for *absolutely dry* sand. Recommended mix for the cooling tank is 4 gallons of water for each sack batch with *wet* sand, 4½ gallons for *damp* sand and 5 gallons for *absolutely dry* sand.

Table 3 also gives suggested proportions of sand and pebbles for the first trial batch. For the footing and foundation wall a trial mix of 1 sack of portland cement, 2¾ cubic feet of sand and 3¾ cubic feet of pebbles is suggested plus the specified amount of water according to the condition of the sand. This should give a smooth, plastic, workable mass that will place and finish well. This is judged by working the concrete with a shovel. It should be stiff enough to stick together, but not dry enough to be crumbly. It should not be thin enough to run. It should be mushy but not soupy. If the suggested mix does not produce workable concrete, change slightly the amounts of sand and pebbles. If the mixture is sloppy, this condition is corrected by adding slightly more sand and pebbles in the proportion of 2¾ parts sand and 3¾ parts pebbles in the next batch. On the other hand, if the mix is harsh and too stiff, cut down slightly on the amounts of aggregates in the next batch. In this way the correct proportion for the job is found. In like manner the best proportions for building the milk house floor and the cooling tank are determined. Note that the suggested trial mix for the floor is 1 sack of cement, 2¼ cubic feet of sand and 3 cubic feet of pebbles or crushed stone; for the cooling tank, it is 1 sack of cement, 1¾ cubic feet of sand and 2 cubic feet of pebbles. Note also that maximum size of pebbles for floor is 1 inch and for cooling tank, ¾ inch.

Table 3—Recommended Proportions of Water to Cement and Suggested Trial Mixes

Kind of Work	Add U. S. gal. of water to each sack batch if sand is			Suggested mix for Trial Batch			Maximum size of coarse aggregate, inches
	Wet	Damp	Dry	Cement Sacks	Sand cu. ft.	Pebbles cu. ft.	
Footings and foundation wall	5½	6¼	7	1	2¾	3¾	1½
Milk house floor	5	5½	6	1	2¼	3	1
Milk cooling tank	4	4½	5	1	1¾	2	¾

PORTLAND CEMENT ASSOCIATION

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33 West Grand Avenue, Chicago

PRINTED IN U. S. A.

F-126—50M—7-33—1